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PACIFIC NORTHWEST WATER LABORATORY QUARTERLY REPORT, APRIL 1 THROUGH JUNE 30, 1969

Federal Water Pollution Control Administration
Portland, Oregon

July 1969

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QUARTERLY PROGRESS REPORT

PACIFIC NORTHWEST WATER LABORATORY CORVALLIS, OREGON

APRIL 1–JUNE 30, 1969

NATIONAL TECHNICAL
INFORMATION SERVICE

FEDERAL WATER POLLUTION
CONTROL ADMINISTRATION
NORTHWEST REGION

CLEAN WATER

PACIFIC NORTHWEST WATER LABORATORY

QUARTERLY REPORT

April 1 through June 30, 1969

United States Department of the Interior
Federal Water Pollution Control Administration
Northwest Region, Corvallis, Oregon

July 1969

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CONTENTS

	Page
OFFICE OF LABORATORY DIRECTOR	1
WASTE TREATMENT RESEARCH & TECHNOLOGY PROGRAM	2
Paper and Allied Products Research Branch	2
Food Wastes Research Branch	4
Regional Research Studies	8
NATIONAL THERMAL POLLUTION RESEARCH PROGRAM	11
NATIONAL COASTAL POLLUTION RESEARCH PROGRAM	17
NATIONAL EUTROPHICATION RESEARCH PROGRAM	26
Physiological Control Branch	27
Ecological Control Branch	30
BIOLOGICAL EFFECTS RESEARCH PROGRAM	37
CONSOLIDATED LABORATORY SERVICES PROGRAM	43
TRAINING & MANPOWER DEVELOPMENT	46

OFFICE OF THE LABORATORY DIRECTOR

In April, Dr. Bartsch attended the 4th International Conference on Water Pollution Research held in Prague, Czechoslovakia. He also visited a number of laboratories where water pollution research directed to eutrophication control is in progress in England, Norway, Sweden, Germany, Italy, and Switzerland.

Dr. Bartsch appeared as a witness in two FWPCA Interstate Enforcement Conferences. On April 2 in Washington, D. C., he presented a "Statement on Eutrophication Conditions in the Upper Potomac Estuary" and on May 13 in Duluth, Minnesota, he presented a "Statement on Eutrophication in Relation to Lake Superior."

Dr. Bartsch participated in a three-day seminar "New Horizons in Environmental Health Biology" held in Hawaii, which was a part of the Program of Continuing Education in Public Health sponsored by the University of California, the University of Hawaii, Loma Linda University, and the Western Regional Office of the American Public Health Association.

WASTE TREATMENT RESEARCH & TECHNOLOGY PROGRAM

9841/1204, 1206, 1210, 1301, 0969-208/11-12

PAPER AND ALLIED PRODUCTS RESEARCH BRANCH - 9841/1204

Status of Activities & Significant Accomplishments

Polymers in Waste Treatment

The laboratory study phase of this project has been terminated and the final report is being prepared. Field studies to evaluate engineering problems connected with the application of polymers will be dependent on final conclusions developed from the laboratory study.

Nutrients in Waste Treatment

A laboratory study is underway to determine optimum nutrient levels for biological treatment of pulp mill waste. This work is a cooperative study with Crown-Zellerbach Corporation which has a FWPCA demonstration grant on secondary treatment of pulp mill waste.

Additional Assignments - 9841/1210, 1301

Additional project area responsibility involving PPB 1210 - Lumber and Wood Products, and PPB 1301 - Forestry and Logging, were assigned to the Paper and Allied Products staff during this quarter. No added funds or personnel were allotted for the remainder of FY 1969 but will be for FY 1970.

Grant and Contract Research Studies

Monitoring and review of Research and Demonstration Grants under Section 5 and 6 continued to occupy the vast majority of available

manpower in the Paper & Allied Products Branch. All projects listed in the second quarterly report are yet active. Those reaching a termination stage are:

1. Beet Sugar Development Foundation, Longmont, Colorado, WPRD 43-01-67.
2. Robertson Pulp and Paper Laboratory, Raleigh, North Carolina, WPRD 115-01-68.
3. Georgia Kraft Company, Rome, Georgia, WPRD 117-01-68.

Additional projects assigned during the quarter are as follows:

1. Department of Forestry, University of Washington, WP 01166-02
2. Department of Civil Engineering, Oregon State University, 12040-EBY.
3. University of Washington, WP 01305-01.
4. Montana State University, 12040-DBD.
5. Klamath Plywood, WPRD 174-01-(R1)-68.
6. Department of Civil Engineering, Oregon State University, WP 01320-02.

Reports and Papers

An interim progress report from the Mead Corporation R&D project, 12040-EMY, was published by the project. FWPCA distribution was directed to agency and industry people concerned with this area of work.

Facilities and Equipment

A Beloit-Passavant Microsieve pilot unit was purchased for in-house field work and industry use to determine application of this equipment in the pulp and paper industry. It is contemplated such equipment will also see use in the Food Wastes Research Branch.

Plans for 1st Quarter, FY 1970

Because of limitations on staff and financial resources, and emphasis on research and demonstration grants, most of the available staff time is expected to be devoted to the review, monitoring, and administration of assigned grant projects in the PPB 1204, 1210, and 1301 areas.

A program of in-house field application and industry use of the Beloit-Passavant Microsieve pilot unit will be developed. Again, in-house work will be supported and dependent on borrowed personnel at a time such help is available.

FOOD WASTES RESEARCH BRANCH - 9841/1206

Status of Activities & Significant Accomplishments

The draft of the final report on secondary treatment of potato processing wastes was reviewed by the Regional Office and by Headquarters.

Many equipment demonstrations and grantees were visited during the quarter.

Two one-liter per day anaerobic trickling filter pilot plants were started. Following an acclimation period they will be fed wastes from corn and bean processing.

Grant and Contract Research Status

Grant preproposals and proposals related to the following subjects were reviewed:

1. Treatment of potato processing wastes using the anaerobic contact process.
2. Aerobic treatment of cereal plant wastes.
3. Evaluation of Santa Clara county fruit cannery wastes as a raw material for fermentation processes and/or an animal feed or animal feed supplement.
4. Development of the most practical and economical method of disposing of waste material from seafood processing plants.
5. Demonstrate the economic and engineering feasibility of the Porteous system to process solid waste material from fruit and vegetable processing.
6. Process upgrading and utilization of potato solid wastes as fertilizer.
7. Extended aeration treatment of dairy plant wastes.
8. Reduction of salt content of food processing liquid waste effluent.

9. Pilot plant installation for use of Fungi Imperfecti on vegetable wastes.
10. Demonstration of a process for economically converting sea food waste to by-products.
11. Waste Brewer's Yeast, a potential indicator organism for establishing the geographical boundaries of a sewage field.
12. State of the art of dairy plant wastes and waste treatment systems.
13. Full-scale demonstration and evaluation of potato dry and wet caustic peeling processes -
14. Evaluation of controlled temperature and forced aeration in trickling filter treatment of food canning waste waters.

Grants assigned (project officer) to the Food Wastes Research Branch and their status follow:

1. "Cannery Waste Treatment by Lagoons and Oxidation Ditch," Melbourne Water Science Institute," Melbourne, Victoria, Australia (WPD 211-02-68).

The second year of pilot plant (two 10-acre anaerobic lagoons and two 120-ft. oxidation ditches) operation was initiated in April.

2. "Status and Research Needs for Potato Waste Waters," University of Washington, Seattle (WP 01486-01-68).

Work is still continuing on the first draft of the report covering the literature search.

3. "State of Art, Sugar Beet Processing Waste Treatment," Beet Sugar Development Foundation, Fort Collins, Colorado (12060 DSI).

Literature search is now under way. Grant had a starting date of April 1, 1969.

4. "Water Pollution Abatement in the United States Seafoods Industry: The State of the Art," Oregon State University, Corvallis (12060 ECF).

Literature review just initiated since it had an effective date of June 1, 1969.

5. "Anaerobic-Aerobic Sugar Beet Waste Treatment," Beet Sugar Development Foundation, Tracy, California (WPD 93-04-68).

Data is being analyzed and first draft of the final report is being written.

6. "Complete Aerobic Treatment of Combined Domestic and Industrial Wastes with Mechanical Aeration," City of Dallas, Oregon, (WPRD 29-01-68).

Construction of facilities is nearing completion. Startup is scheduled for July 7, 1969.

7. "Aeration of Fruit Processing Wastes," Snokist Growers, Yakima, Washington (WPRD 58-01-68).

A draft of the final report is being reviewed by FWPCA.

8. "Aerobic Secondary Treatment of Potato Processing Wastes with Mechanical Aeration," R. T. French Co., Shelley, Idaho, (WPRD 15-01-67).

About four weeks of additional construction will be required to complete the facility.

Areas of Concern

Continued backlog in paperwork related to both ongoing grants and new applications for grants results from a lack of adequate manpower for this program.

Plans for 1st Quarter, FY 1970

Continue work on ongoing grants and new applications and initiate pilot plant sutides on treatment of vegetable processing wastes.

REGIONAL RESEARCH STUDIES (In previous quarterly reports this section was referred to as "Special Studies Branch.")

Status of Activities & Significant Accomplishments

Waste Treatment at Recreational Areas - 0969-208-11

A draft of a working paper on Evaluation of Extended Aeration Treatment at Recreation Areas has been prepared and distributed for preliminary review.

Analysis of data from the surveys of summer recreation areas is nearly completed and analysis of the bench-scale pilot plants has begun.

The pilot plant at Philomath, Oregon, which has been used the last 9 months to study the treatment of domestic wastes under conditions simulating those at some recreational sites where severe fluctuation of waste quantity and quality occurs, will be shut down early in July for release to the Food Processing Waste Section.

Log Handling and Storage - 0969-208-12

The scope of the Log Handling and Storage Project has been revised to avoid duplication of work being done under a FWPCA research grant at Oregon State University, since the work at OSU is covering a larger area than originally proposed. Characterization of wastes from log ponds and sprinkling of cold decks will be done by OSU rather than PNWL, and the study of steam vat wastes was deleted from the project objectives as it was covered in another project. Consideration is being given to having OSU, rather than PNWL, conduct a survey of log storage facilities in the Pacific Northwest. All study sites for the biological effects aspect of the project have been selected.

Animal Feed Lot Waste Disposal (This is a new project strongly desired by the states of Oregon, Washington, Idaho, and Montana.)

Work is now underway to develop a project proposal. Meetings with the Sanitary Authorities of Washington and Oregon have been conducted to determine their desires with respect to this subject.

Reports and Papers

The final report for the Plywood Glue Waste Study, entitled "Plywood Plant Glue Waste Disposal," has been published and distributed.

The pilot plant at Philomath, Oregon, which has been used the last 9 months to study the treatment of domestic wastes under conditions simulating those at some recreational sites where severe fluctuation of waste quantity and quality occurs, will be shut down early in July for release to the Food Processing Waste Section.

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Reports and Papers

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The final report on the aerated lagoon treatment of food processing waste has been reviewed and is now in the process of being prepared for publication.

Plans for 1st Quarter, FY 1970

Aerated Lagoon Treatment of Food Processing Wastes

The final report for this project should be published and the project closed.

Waste Treatment at Recreational Areas - 0969-208-11

Analysis of data from the summer surveys, bench-scale pilot plants and the Philomath pilot plant will constitute virtually 100 percent of the activity in this project.

Log Handling and Storage - 0969-208-12

Sampling for the biological effects aspect will be completed, as will the review of literature concerning economic factors affecting log handling and storage practices.

Animal Feed Lot Waste Disposal

Meetings to assist in the preparation of the project proposal will be held with regulatory agencies of Idaho and Montana. Visits are being planned to other regional offices and other state agencies to acquire information already developed and to coordinate activities with the research program of the Ada Laboratory.

NATIONAL THERMAL POLLUTION RESEARCH PROGRAM

9841/1613

Status of Projects & Significant Accomplishments

Consultation and Advisory Services

The seventh and final Technical Seminar on Thermal Pollution was held April 10-11, 1969 in the Southwest Region, San Francisco, California. Upon completion of the seminars, a digest of research needs in thermal pollution control, as expressed by seminar participants from a wide variety of scientific disciplines and professional backgrounds, was prepared by NTPRP.

Assistance was provided the South Central Region during April on (1) estimates of natural and mechanical draft cooling tower requirements with a brief discussion of costs; (2) pertinent facts relative to dispersion of heat; and (3) comments on the report of the hydraulic model investigations conducted by Bechtel.

During May information was provided the Duluth Laboratory in the form of comments by Dr. Tichenor on experimental ponds proposed for Monticello, Minnesota.

Dr. Garton represented NTPRP at a committee meeting at Oregon State University on May 26 on "Beneficial Use of Cooling Water in Aquaculture," to discuss likely areas of research on beneficial effects of thermal power plant waste water.

In June technical assistance was provided the Ohio Basin Region in compiling information on costs associated with cooling condenser discharge water, and the problem of stream temperature prediction.

We reviewed non-federal testimony presented at the public hearings on New York Water Quality Standards at the request of the Acting Director, Water Quality Standards staff.

At the request of the Acting Assistant Commissioner for R&D, comments were made on a "Draft of the Department of Interior's Position on Thermal Discharges from Steam Electric Power Generating Facilities."

An evaluation of PGE's Trojan Plant plans was provided the Northwest Region, FWPCA.

Sources of Heat Input to Water

Progress was made in the simulation of the field set-up and testing on instrumentation to be used in this summer's field study on covered cooling ponds and stream evaporation. A site on the Little Deschutes River of Central Oregon was selected for the study which is scheduled to begin July 21, 1969.

Larry Winiarski and Ken Byram have a transient time-temperature program running on the teletype for use in thermal studies.

Effects of Heat Management on the Environment

Laboratory facilities were set-up to study effects of a hot water lens on the emergence of aquatic insects. The purpose of this study is to determine whether hot effluents to water surfaces will be harmful

to an insect population when the hot water is floated on cool water and insects contact this hot layer only during emergence.

Effects of Temperature on Fresh and Marine Fish Species

See Biological Effects Research Program Report, page 37

Engineering and Cost Aspects of Heat Dissipation

"A Mathematical Model of Natural Draft Cooling Tower Performance," a paper by Larry Winiarski and Bruce Tichenor, was approved for presentation at the ASCE Sanitary Engineering Division's Second National Symposium on Sanitary Engineering Research, Development and design, Cornell University, July 16, 1969.

Local Meteorological Effects of Cooling Towers

The report, "Cooling Towers and Weather," by Fred Decker, Associate Professor of Physics, OSU, was distributed to all the Regions and to Headquarters.

Design Criteria for Heat Discharge Outfalls

The USGS endorsed cooperative research with NTPRP at the Fluid Dynamics Laboratory at Colorado State University on turbulence diffusion.

Plans were finalized for instrumenting a modest laboratory for fluid dynamics research at Pacific Northwest Water Laboratory.

General

Dr. Garton attended the Richland, Washington meeting of the Columbia River Thermal Effects Advisory Committee, April 23-24, 1969.

Mr. Rainwater participated in a seminar on criteria for aquatic life held jointly by the Office of Operations and the Office of R&D, Headquarters, April 29, 30.

Mr. Rainwater also attended the bi-annual meeting of the Cooling Tower Institute in Washington, D. C., June 16-18, 1969.

Grants and Contracts

Awarded - Fourth Quarter

1. Cornell Aeronautical Laboratory, "Research on the Physical Aspects of Thermal Pollution," awarded 4/10/69.
2. Littleton Research Corporation, "Proposal for an Economic-Engineering Study of Cooling Ponds," awarded 4/16/69.
3. Cornell University, "Heat and Water Vapor Exchange between Water Surface and Atmosphere," awarded 5/22/69.
4. E. Bollay and Associates, EG&G, "Theoretical Evaluation and Development of Criteria to Determine Inadvertent Weather Modification in the Vicinity of Cooling Towers," awarded 5/28/69.
5. Tetra Tech, "Studies on the Effects of Waste Heat Discharge from Nuclear Power Plants into Large Bodies of Receiving Water," awarded 6/25/69.

Technical reviews of formal proposals for research grants, demonstration grants, and contracts were provided for the following subject matters:

1. Thermal Pollution of Waterways

2. Non-Evaporative Cooling Towers
3. The Dissipation of Waste Heat Through Discharge into Underground Water Strata
4. Flow and Dispersion of Warm Water Discharged into Lakes and Rivers
5. Feasibility of Controlling Thermal Pollution by Underground Injection
6. Utilization of Thermal Effluents for Agricultural Uses
7. Sale of Steam as Thermal Pollution Control Measure and Revenue Producer for Central Power Stations
8. Thermal-Water Horticultural Demonstration Project
9. Request for Co-Funded Research Contract to Investigate the Beneficial Uses of Heated Discharges
10. A Development of Improved Techniques for Micro-Modeling of Temperature Distribution in the Vicinity of Heated Outfalls
11. Thermal Pollution Model Development
12. A Proposed Study of Thermal Plume Diffusion in the Great Lakes
13. Demonstration of Multispectral Sensing for Assessment of Water Quality
14. A Theoretical and Experimental Investigation of Mass and Energy Transfer in Film Flows
15. Field Measurements to Assess Possible Inadvertent Climate Modifications
16. Turbulent Bed Cooling Tower

17. Studies in Pollution Biochemistry

18. A Proposed Study of Thermal Plume Diffusion in the Great Lakes

In addition to the above, 9 preliminary grant and contract research proposals were reviewed.

Areas of Concern

None, except need for additional engineering personnel.

Reports and Papers

Dr. Shirazi gave a talk on "Thermal Pollution of Water Resources" at the Environmental Health Engineering Seminar at Washington State University, Pullman, Washington, May 1.

Dr. Garton presented a seminar-lecture on thermal pollution at Colorado State University, presenting a general view of causes and effects of thermal pollution and a description of the purpose and activities of the National Thermal Pollution Research Program, June 17, 1969.

Plans for the 1st Quarter, FY 1970

Concentrate efforts on intramural research at Pacific Northwest Water Laboratory and Colorado State University, as described above. Instrument lab facilities for fluid dynamics research at PNWL.

NATIONAL COASTAL POLLUTION RESEARCH PROGRAM

9841/1607

CHEMICAL/BIOLOGICAL OCEANOGRAPHY BRANCH

Status of Projects & Significant Accomplishments

Biological Assessment

A training course, "Quantitative Evaluation of Biological Information Obtained in Coastal Waters," was held at the Pacific Northwest Water Laboratory, April 22-23. Drs. Saul Saila, University of Rhode Island; Henry Regier, University of Toronto; Howard Sanders, Woods Hole Oceanographic Institute; and John McGowan, Scripps Institution of Oceanography, served as lecturers for the course. Thirty-five representatives from coastal regions of FWPCA, local personnel, and Oregon State University Statistics and Oceanography Departments attended.

The objectives of the training course were, first, to instruct senior scientific investigators from our technical investigations program in available methods for conducting marine biological investigations related to pollution control activities; and, second, to provide a framework for the research program participants involved in continued efforts to improve the state of the art on this topic.

Atmospheric Reaeration and Excess Nitrogen Transfer in Polluted Estuaries

Three field releases of dye as a tracer were accomplished, one with radionuclides. An apparatus was constructed, installed, and

operated to dose and obtain samples, operable at various depths with a considerable degree of automation. It will handle various inputs and sample taking.

Plans have been made with the South Central Regional Office, the Ada Laboratory, and our program for a cooperative study of reaeration in Galveston Bay, planned for August-September of this year. A proposal and equipment outline was sent to the South Central Regional Office.

Analysis of Dredge Spoils and Other Solids Disposal Practices in the Ocean

In May successful field studies were conducted in Bellingham Bay to test the in situ benthic respirometer, in cooperation with Dr. Berg of Seattle University.

NAS-NAE State of the Art Report

The National Academy of Sciences-National Academy of Engineering, Washington, D. C., is under contract to FWPCA to prepare a state of the art report on management of wastes in the coastal environment. In preparation for the meeting of working groups to be held in Jackson Hole, Wyoming, July 7 - 12, the NCPRP coordinated information requested and received from the Water Pollution Surveillance Branch and each coastal Regional Office concerning projects now underway and problems which require attention.

PHYSICAL OCEANOGRAPHY BRANCH

Status of Projects & Significant Accomplishments

Columbia River Estuary Temperature Model

Topographic channel data and tributary flow information of the lower 28 miles of the Columbia was completed and recorded on key punch cards. By virtue of the salt content in the lower river, this section constitutes the 'estuary' proper.

Boston Harbor Model

Mr. Dan Fitzgerald of the Northeast Regional Office was provided with program listing, deck and copies of background material on the Water Resources Engineers model. The main features of the model were pointed out to him with the possible application of the model to Boston Harbor in mind.

Estuarine Diffusion of Pollutants

In May 1969 a contract was awarded to TRACOR, Sciences and Systems Division, Austin, Texas, for the purpose of organizing the technical sessions and completing a report on the relative merits and limitations of digital, analog-electronic, hybrid, and hydraulic models in estuarine pollution problems. The award was made on the basis of reviews by FWPCA officials of 19 proposals in response to an invitation for bids advertisement.

The first technical session, June 24, St. John's College, Annapolis, Maryland, was designed primarily to familiarize chapter

authors and reviewers with all FWPCA estuarine problems and the modeling methods employed in their solution, and to reach agreement on chapter content. Seventeen FWPCA representatives attended this session and presented summaries of modeling needs in each of their regions.

The arrangement of the six chapters and suggested authors is as follows:

I. Introduction - FWPCA.

II. Hydrodynamic Models - Dr. Pritchard, Johns Hopkins; Dr. Harleman, MIT.

III. Physical Hydraulic Models - Dr. Harleman.

IV. Water Quality Models - Drs. O'Connor and Thomann, Manhattan College; Dr. Orlob, WRE, California.

V. Solution Technique - Dr. Harder, U. of California; Dr. Orlob.

VI. Case Studies - TRACOR.

Reviewing chapter content will be Drs. Paulik, Dobbins, Rattray, Ippen, Masch, and Keulegan.

The next technical meeting will be in approximately three months, possibly in Dallas, Texas, following the Water Pollution Control Federation meeting. Final review of the chapters will be made then.

Site Selection for Waste Discharges in Pacific Northwest Coastal Waters

A grant was awarded to the Oceanography Department, OSU, to evaluate the state of knowledge of the nearshore coastal waters from Cape Mendocino, California, to Cape Flattery, Washington, excluding

the coastal estuaries. The evaluation will be directed to the consequences of siting waste discharges, particularly thermal loads from electric power plants. Regions possessing unusual sensitivity and characteristics for possible exploitation (such as rips, rapid mixing, or low water use potential) will be identified.

The geographical limits of the study were established to provide coverage as broad as possible after consideration of similar oceanographic features of the West Coast and the capabilities of the university. The study may delineate smaller regions of similarity within this stretch of approximately 400 miles.

Deficiencies in the state of knowledge, especially for predicting the effects of waste discharges, will be identified for subsequent research attention.

The results of the study are expected to be immediately useful to the planning and control activities of the states of Oregon, Washington, and the Northwest Region of the FWPCA.

Other Activities

Chief, Physical Oceanography Branch, attended a symposium of the Scientific Advisory Committee - National Data Buoy System, at the U. S. Coast Guard Academy, New London, Connecticut, in May. The meeting was arranged to discuss various government and nongovernment opinions on what kinds of data should be obtained at each buoy location,

the frequency of sampling, location of buoy networks, number of buoys, etc. Statements of FWPCA interests were submitted to the committee and included in their draft report.

PROBLEM ANALYSIS AND ENGINEERING DEVELOPMENT BRANCH

Status of Projects & Significant Accomplishments

Ocean Outfalls

The draft of "Part I: Literature Review and Theoretical Development" for the report, "Design of Ocean Outfalls" has been completed and forwarded to experts in this field for technical review. This report will be published in two parts.

Lake Superior Pollution

A technical analysis and a brief laboratory model study in conjunction with OSU were conducted to determine the fate of solids discharged to Lake Superior by Reserve Mining Company near Silver Bay, Minnesota. It has been postulated that after the waste leaves the delta, it flows as a density current to the bottom of Lake Superior. From our studies it was concluded that the discharge most likely results in an unstable density flow which spreads out and becomes diluted as it flows down the face of the delta, shedding clouds of finely-divided particulate matter. The results of these studies were presented by the Chief, NCPRP, at the Lake Superior Enforcement Conference held May 12, Duluth, Minnesota.

Design of Barge Disposal Systems

A research and development program is in preparation for the control of pollution from barge dumping, and work has started on the preparation of a state of the art report. Emphasis in this report will be placed on the magnitude of the problems, methods for describing the fate and distribution of barge dumped wastes, recommended evaluation and control procedures, and areas of needed research.

Grant and Contract Research

Technical reviews were provided on applications and proposals for research grants and contracts related to the following subjects:

1. An Industrial Wasteline System
2. Collection and Analysis of all Geophysical and Oil Pollution Data Associated with the Santa Barbara Oil Spill - 16070 ECE
3. A Membrane Salinometer for Monitoring Estuaries - 16020 DXT
4. Studies on Wind-driven Circulations off the Coast of California, Gulf of Mexico, and the Great Lakes - 16070 ECR
5. Study of the Dredging Effects on Marine Ecology.
6. Preliminary Proposal to Develop Techniques for Predicting the Dispersion of Oil at Sea.
7. Dispersion in Hydrologic and Coastal Environments - 16070 DGY
8. Investigation of Microlayer Collection for Pollution Measurement - 16020 ELV

9. The Development of Methodologies for Planning for the Optimum Use of the Marine Resources of the Coastal Zone - 16070 ENB
10. Mathematical Model Development for Coliform Reduction in Shallow Bays and Estuaries - 16070 EBM
11. Proposal for Precision In Situ Sea Water Densitometer - 16020 EMK
12. Waste Brewer's Yeast, a Potential Indicator Organism for Establishing the Geographical Boundaries of a Sewage Field - 16030 EML
13. Preproposal for Mathematical Modeling of Barge Disposal of Concentrated Liquid Wastes
14. Baseline Water Quality Study of the Alaskan Arctic Estuarine Environment - 18070 EØM

Equipment

A purchase order has been awarded to Geodyne to provide a magnetic tape data acquisition system consisting of current speed and direction, temperature, salinity, and pressure, plus a string of ST probes. The instrument package may be operated as a ship mounted survey system or as an anchored monitoring station.

Plans for 1st Quarter, FY 1970

CHEMICAL/BIOLOGICAL OCEANOGRAPHY BRANCH

Atmospheric Reaeration

Further runs on tracer measurement of reaeration rates in Yaquina estuary are planned; it is desired that the entire procedure

be simplified and routinized so that subsequent runs can easily be arranged. The set of measurements will be greatly simplified if an *in situ* radioactivity detector now in planning state can be developed.

The next estuary to be examined for this basic parameter is the Galveston Bay system. Conversations are being held with the Southwest Region personnel planning a cooperative project for this purpose.

PHYSICAL OCEANOGRAPHY BRANCH

Columbia River Temperature Model

The lower estuary model will be run against U. S. Corps of Engineers data to verify tide height and mean velocity data. The first draft of the users' manual will be completed.

Estuarine Diffusion of Pollutants

Internal review of completed portions of the state of the art report will be made.

PROBLEM ANALYSIS AND ENGINEERING DEVELOPMENT BRANCH

Design of Barge Disposal Systems

In-house experimentation and the state of the art report will be started.

Ocean Outfall Design

Reviews will be received and changes incorporated into the draft report, "Design of Ocean Outfalls - Part I." A final copy will be completed and submitted for clearance. Work will continue on Part II; a first draft will be written.

NATIONAL EUTROPHICATION RESEARCH PROGRAM

9841/1601 and 9884/000

General

A Provisional Algal Assay Procedure Evaluation Conference was held at the Robert A. Taft Water Research Center in Cincinnati, Ohio, on May 5-6. The conference was attended by Dr. Bartsch, Mr. Maloney and Mr. Miller from the Pacific Northwest Water Laboratory. Other attendees included representatives from the three universities involved in the evaluation of the PAAP under the Federal Water Pollution Control Administration research grants, various industries, and other government installations.

Dr. Bartsch served as the United States representative at the second Expert Meeting on Lake and Reservoir Management (Eutrophication) under the auspices of the OECD in Paris, France.

Dr. Knittel attended the annual meeting of the American Society of Microbiologists held in Miami, Florida.

Mr. Maloney visited various laboratories in Europe June 15-18 to discuss eutrophication problems and algal assay procedures.

Dr. Bartsch attended a meeting of the Joint Industry/Government Task Force on Eutrophication held in Washington, D. C.

Dr. Bartsch and NERP staff members participated in the Eutrophication-Biostimulation Assessment Workshop held at Berkeley, California, June 19-21.

PHYSIOLOGICAL CONTROL BRANCH

Status of Projects & Significant Accomplishments

Algal Assay Procedures Section

The evaluation of Selenastrum capricornutum as a test organism in algal assay procedures, both batch and continuous-flow, has continued. While no difficulties have been encountered in the use of the organism in the "bottle test", attempts to maintain a continuous-flow culture of this alga have been unsuccessful. The chief problem appears to be bacterial growth within the system. To minimize this, the influent and effluent sample bottles will be refrigerated to 4°C. Other chemostat modifications, adopted at the PAAP Evaluation Conference have been incorporated into our continuous-flow culture systems.

Studies were continued to evaluate methods for measuring algal biomass in cultures of S.capricornutum. Excellent correlation has been found between fluorometer (chlorophyll) measurements and cell numbers (Coulter Counter).

"Bottle test" algal assays were carried out on water and sewage samples in connection with the Shagawa Lake Eutrophication Control Project. Samples tested included Shagawa Lake water, water from Burntside River, the major stream entering into Shagawa Lake; and tertiary effluent from a pilot treatment plant which empties into Shagawa Lake. While Shagawa Lake water supported good growth of both S. capricornutum and Microcystis aeruginosa, there was minimal algal growth in both Burntside River water and tertiary effluent.

Aquatic Plant Control Section

Approximately 150 cultures of bacteria were isolated from water of ponds and lakes in the area, and screened for algicidal or algistatic activity against the two blue-green algae, Anabaena flos-aquae and Microcystis geruginosa. Fifteen of the bacterial isolates exhibited some anti-algal activity to one or both of the algae The primary screening consisted of a spot plate technique. The active bacterial cultures have been purified and some limited morphological data obtained. Most species are gram negative rod-shaped and one species is a gram positive spore-forming rod.

Physiology Section

Experiments were continued to define the nitrogen and phosphorus requirement for the growth of S. capricornutum. This is being done in order that a culture medium can be devised which will minimize endogenous carry over of these nutrients in algal cells being used as inocula in assay studies. Cultures were grown in medium containing growth-limiting concentration of nitrogen and phosphorus, and in medium containing nitrogen in concentrations ranging from 0 to 14.0 mg/ℓ, and in phosphorus concentrations ranging from 0 to 0.62 mg/ℓ. Preliminary results showed that the best growth occurred at 3.5 mg N/ℓ and 0.1 mg P/ℓ.

Grant and Contract Research

Research grants have been awarded to the University of California, Berkeley; the University of North Carolina; and the University of Wisconsin, Madison, for evaluation of the Provisional Algal Assay

Procedure. The general objective of this research will be to evaluate the continuous culture method as a means of assessing algal growth kinetics in different waters in comparison with the batch culture technique. Determination of the validity of the kinetic model in explaining the obtained results will be part of this evaluation.

Technical reviews of preproposals and proposals for research grants, demonstration grants, and contracts were provided for the following subjects:

1. Nutrient Sources for Algae and their Control.
2. Effect of Phosphorus Removal Processes on Algal Growth.
3. Viral and Bacterial Pathogens as Microbial Algicides.
4. Organic and Inorganic Nitrogen in the Growth of Algal Blooms.
5. Phosphate Adsorption and Utilization by Algae-A Comparative Study.
6. Texas Soil Algae.
7. Isolation and Characterization of Viruses to Nuisance Algae.
8. Algae as Biological Indicators of Thermal Pollution.
9. Eutrophication in Coastal Waters; Nitrogen as a Controlling Factor.
10. Some Aspects of Microcrustacean Phosphate Metabolism.
11. Viral Infections of Blue-Green Algae, Practical and Theoretical Aspects.

12. Study of the Physiological and Ecological Facts which Control the Mass Development of Blue-Green Algae as a Contribution to their Control in Nature.

Plans for 1st Quarter - FY 1970

The evaluation of S. capricornutum as a test species for both batch and continuous-flow assays will continue. Algal assays will continue to determine the biostimulatory effects of water samples and sewage effluents in connection with the Shagawa Lake Eutrophication Control Project. Algal assays will also be carried out on water samples from lakes representing various trophic levels ranging from oligotrophic to eutrophic. The use of ventilation, as opposed to aeration, in continuous-flow culture will be evaluated.

Screening of bacterial cultures for anti-algal activity will continue and an attempt made to quantitate anti-algal activity. A search for blue-green algal viruses will be initiated.

Studies will be conducted to determine the optimum N to P ratios for minimization of nutrient carryover in the PAAP algal test species.

ECOLOGICAL CONTROL BRANCH

Status of Projects & Significant Accomplishments

Nutrient Control Section

The field study to investigate the effect of hypolimnetic aeration and destratification on nutrient availability and algae production has continued through the second quarter on Cline's Pond. Background data

obtained prior to inducement of turnover confirmed the existence of severe thermal and chemical stratification. Plastic barriers were then erected, partitioning the pond into an experimental section and a control section. Bubbling of air through the experimental section completely eliminated existing thermal and chemical stratification. Leakage at the bottom of the partitions, however, permitted partial turnover of the control section. This problem appears to have been solved by staking the plastic firmly to the bottom at close intervals. The entire pond was permitted to return to a natural stratified equilibrium, and aeration was resumed. The partitions appear to have achieved an effective seal, and it is believed that the experiment will now proceed satisfactorily.

The Waldo Lake study was scheduled to begin in July (the earliest time that access was possible) and as of the first week in July the first chemical-biological survey has been successfully completed. These data will appear in the first quarterly progress report of FY 1970.

The project to study nutrient content of precipitation is presently concerned with an effort to obtain a non-contaminating rainfall collector. A satisfactory model appears to have been developed in Canada at the Hamilton Great Lakes Laboratory; possibilities of obtaining or fabricating a similar device are good.

Analytical data for the Detroit Lakes study have been forwarded to this laboratory, and tabulated and graphed for progress review. The field soil lysimeter operation was terminated because the soil attained capacity fixation for phosphates. Lake Sallie sediment samples continue to be forwarded to the Pacific Northwest Water Laboratory for nutrient analysis. Experiments for monitoring nutrient uptake by aquatic plants have been initiated and are continuing.

Sediment-Water Interchange Section

A contract for supply of six 20-foot circular experimental pools to be used in field experiments on elimination of sediment-water nutrient interchange was awarded. These pools will be fabricated with nylon reinforced polyvinylchloride. It is anticipated that one pool will be in place in Upper Klamath Lake sometime in July. Laboratory experiments on inhibition of nutrient interchange showed that addition of aluminum (as Boliden pellets) or lanthanum to Upper Klamath Lake water significantly reduced orthophosphate concentration and algal (Selenastrum) growth, regardless of whether the water was underlain by sediment. However, Oscillatoria eventually proliferated on the bottoms of the aquaria, particularly in those containing sediment. This occurred in aquaria which had been treated with aluminum as well as those which had been treated with lanthanum, in spite of the thick mat of hydrous metal oxide which had been precipated. In fact, growth of Oscillatoria was much heavier in the aluminum-treated aquaria. Large gas bubbles eventually formed and masses of Oscillatoria

rose to the surface in much the same manner as had been observed in Upper Klamath Lake. These experiments confirm previous beaker experiments which showed that aluminum did not prevent algal growth, and that lanthanum was somewhat more effective as an inhibitor. A further disadvantage of flocculated aluminum hydroxide is the extreme ease with which it can become resuspended.

Significant seasonal changes in the chemistry of interstitial water from Upper Klamath Lake sediments are being observed. There was a steady decrease in most nutrients from April until early June, followed by an increase toward the end of June. A like pattern was found last year.

Planning for full-scale lake restoration projects has resulted in the development of criteria for use in the selection of lakes for dredging or treatment experiments. Preliminary contacts are being made, primarily in the midwest, in an effort to locate suitable experimental lakes.

Shagawa Lake Project

A modified design for in-lake basin experiments was worked out during this quarter. Three sizes of basins are being utilized - 150,000 gallon, 100 gallon, and 8 gallon. Experiments were initiated in June. Algal production and nutrient cycles in mixtures of Burntside River water (the principal inflow to Shagawa Lake) with secondary and tertiary effluent are being observed in the two smaller size

scale experiments, and the effects of enrichment and/or dilution of Shagawa Lake water with those effluents are being studied in the large basins.

An autoanalyzer for the Shagawa Lake project laboratory was fabricated from components lent by PNWL. The instrument will be operational in July.

PAAP laboratory tests are being conducted by PNWL and Proctor & Gamble laboratories on mixtures similar to those being utilized in the in-lake basin experiments.

Grant and Contract Research

Technical reviews of preproposals and proposals for research grants, demonstration grants, and contracts were provided for the following subjects:

1. Phosphorus in Aquatic Ecosystems, Model Experiments.
2. Sediment-Water-Bacteria Interaction in Eutrophication.
3. The Role of Sludge Worms in Promoting Eutrophication
4. Application of Clay Minerals to Control the Algal Nutrient Content in Fresh Water Lakes and Ponds.
5. Isotopic Composition of Lake Michigan Sulfur as a Tool for Studying Potential Eutrophication.
6. Use of Lake Sediment Cores to Estimate Eutrophication.
7. Algae Control in Eutrophying Lakes.
8. Harvesting Algae from a Lake - Feasibility Study.
9. Effect of Phosphorus Removal Processes on Algal Growth.

10. Silt Removal from a Lake Bottom.
11. Inshore and Offshore Differences in Nutrients and Plankton and their Significance to Eutrophication of Lake Michigan.
12. Seasonal Change in Species-Diversity and Biomass of Phytoplankton, Zooplankton, Benthos, and Fishes in Lake Wingra, and the Productivity of Index of this Lake.
13. Artificial Aeration of Lakes.
14. Ostracodes as a Tool in Interpretation of Ecologic Evolution of Lakes.
15. Photosynthesis Rates and Productivity of Aquatic Weeds.
16. Limnology of Lake Tahoe Emphasizing Water Quality.
17. Nutrient Control Project.

Reports and Papers

A paper by A. F. Bartsch and C. F. Powers entitled "Changes in the Great Lakes and Present Status" was presented by Dr. Powers at tne American Chemical Society meeting at Minneapolis, Minnesota.

At the Eutrophication Biostimulation Workshop, Berkeley, California, Mr. Gahler presented a paper entitled "Sediment-Water Nutrient Interchange" and Dr. Powers presented one entitled "Shagawa Lake Project."

Areas of Concern

The gaging structure at the outlet of Waldo Lake has not been installed.

Various problems have been hampering processing of chemical samples at Shagawa Lake, although the situation now appears more optimistic with the prospect of an automatic analyzer achieving working status. The most recent problem at Ely is the accidental spillage of 500 to 1000 gallons of fuel oil into the municipal sewage system. Experiments are curtailed until the city plant can be completely cleaned, probably resulting in a loss to us of about one week. None of our equipment was contaminated.

Plans for 1st Quarter, FY 1970

In Nutrient Control the destratification experiments at Cline's Pond will continue. Waldo Lake will be surveyed once each month. Laboratory experiments on nutrient transport through a thermocline and on nutrient uptake by rooted aquatics will continue.

In Sediment-Water Interchange, one experimental pool will be installed in Upper Klamath Lake as soon as received. Efforts will continue to locate suitable lakes for dredging and other restoration experiments. Field studies on seasonal variation of nutrient content of interstitial water in Upper Klamath Lake and Lake Erie will continue, as will laboratory experiments relating to assay procedures and to inhibition of nutrient interchange.

At Shagawa Lake Project, the experimental procedure initiated in June will continue throughout the coming quarter. Spiking experiments as well as experiments involving sewage effluent mixtures will be conducted.

BIOLOGICAL EFFECTS RESEARCH PROGRAM

Status of Projects & Significant Accomplishments

Thermal Pollution Studies

1. Tissue Enzyme Studies

Since temperature can affect the pH of buffers, the pH of tris-HCl, and phosphate buffers were determined over the range of temperatures used in the enzyme assays. Phosphate buffer maintained a rather steady pH, but the pH of the tris buffers declined with increasing temperature. All subsequent assays were conducted using tris buffers adjusted to produce the desired pH at each temperature used. To date pH change has produced no qualitative and little quantitative difference between earlier assays and recent assays of leucine amino naphthylamidase (LAN) and cholinesterase (ChE).

With the acquisition of juveniles of three species of fish (sockeye salmon, chinook salmon, and steelhead trout) in addition to the previously used coho salmon juveniles, enzyme assays were extended to include all four species. In vitro assays of enzyme activity were performed using preparations from selected tissues. Liver leucine amino naphthylamidase (LAN), which we reported earlier to be labile at supralethal temperatures in coho salmon, was found to have maximum activity at about 45°C. This temperature optimum was the same in all four species of salmon, both in liver homogenate and in the high speed supernatant fraction.

Lactic dehydrogenase (LDH) activity in the high speed supernatant fraction of muscle was maximum at about 25°C (all four species). LDH activity in whole homogenate of muscle was also maximum at about 25°C (chinook salmon is the only species thus far investigated in this respect). LDH activity was measured over a range of pH values; optimum activity was between pH 5-6 and declined at higher pH values.

The relatively heat labile fraction of cholinesterase found in the 40,000 X G supernatant accounted for only 5 to 10 percent of the total cholinesterase activity in brain tissue. This fraction has a poorly defined peak of activity with respect to temperature, having instead rather constant activity between 20 and 38°C which declines markedly above 38°C. The remaining 90 to 95 percent of the cholinesterase activity in brain homogenate had a distinct peak of activity which increased rapidly up to 38°C and then dropped off sharply at higher temperatures. No pseudo-cholinesterase activity, as measured by butyryl choline breakdown, was found in the supernatant fraction.

Additional space has been obtained for holding fish, and a large portion of the old wet laboratory facility (375 sq. ft.), is being modified to study the effect of temperature acclimation on enzyme activity. Recent laboratory water supply temperatures above 20°C have caused considerable concern for the condition of the fish intended for enzyme studies. No further work can be performed until a recently

acquired chiller is installed to supply colder water to the fish. The chilled water supply will also make it possible to run a number of experiments relating in vivo temperature exposure and enzyme activity.

2. Simulation of Adult Salmon Migration Through Elevated Temperatures

Reinstallation of equipment at the Bonneville test site was completed. An initial attempt to perform a pilot test of the facility with spring chinook was aborted when the North Bonneville fish trap became inoperative. A subsequent pilot study was conducted using adult spring chinook which seemed to do well at temperatures below 20°C. Those held in water heated from ambient temperature (12°C) to 22°C over a four-day period became lethargic above 20°C and could be captured by hand, without nets, and examined out of water without anesthesia. At this point, the condition of these fish was deemed grave; hence, they were returned to ambient river temperature. However, their condition continued to worsen in comparison to the unheated control fish, and the short but stressful two-hour period at 22°C apparently instituted progressive tissue damage and disease. These observations emphasize the important relationship of environmental stress and disease. After about four weeks, one of the three "heated" fish died and the remaining "heated" fish were in very poor condition. At this time the pilot study was terminated and all the surviving adult chinooks were released back into the Columbia River.

The pilot study also established that some aspects of the holding facility required modification to prevent adult salmon from damaging themselves. Since the termination of the pilot study, considerable effort has been devoted to completing these modifications before the full-scale studies begin July 1.

Facilities for routine water quality testing were developed. Additional piping was installed to provide an emergency source of condenser water. An air blower and distribution lines were installed. Flow patterns and temperatures within the holding tanks were tested and found to be excellent. Overhead netting was installed to prevent fish from jumping higher than 6 feet to escape the tanks. Alarm systems were installed to signal a failure of pumps or heaters. Brush and low limbs were removed from the grounds as a deterrent to potential vandals. Numerous other tasks were completed.

Adverse Properties of Sulfite Waste Liquor (SWL)

Steelhead eggs which had been washed in water to remove excessive ovarian fluid and then fertilized in isotonic saline and Alsea River water with varying concentrations of sulfite waste liquor were examined for fertility and counted. SWL at a concentration of 575 ppm in isotonic saline reduced the average percent fertility from 95 percent to 4 percent. In Alsea River water the SWL reduced the average percent fertility from 92 percent to 6 percent. The percentage of fertile eggs was reduced to less than 50 percent by SWL in isotonic

saline at concentrations between 200 and 300 ppm. In Alsea River water, SWL reduced the percentage of fertile eggs to less than 50 percent at concentrations between 300 and 450 ppm. The average percent fertility for controls was always greater than 90 percent. Since the threshold of toxicity for SWL to adults is greater than 1,000 ppm, the observed gametocidal effects at 200 ppm are highly significant.

Earlier results with coho salmon eggs, fertilized under control conditions and reared in artificial redds receiving 50 ppm SWL indicated that the presence of 50 ppm of SWL was associated with moderate mortality (21 percent), early hatching and premature emergence. Similar studies with steelhead eggs have failed to produce such marked effects. However, it should be pointed out that during the steelhead experiment an alternate source of SWL was used and the difference in results may be ascribable, at least in part, to the different waste. Also, water temperatures were much warmer and the steelhead hatched in about one-third of the time required by coho.

The main effort was devoted to planning our fertilization studies for the fall 1969 spawning season. An artificial stream channel is being designed and constructed that may allow adult salmon to spawn naturally. If this proves to be successful, several pollutants will be tested to determine the effect on spawning behavior and fertilization.

A chronic toxicity study is being set up to determine the long-term effects of paper trade wastes containing zinc hydrosulfite.

Areas of Concern

The workload continues to increase without a concurrent increase in trained research staff. As a result, no further assignments can be accepted without a partial deactivation of ongoing projects.

A most important area of concern, not only to this branch, but to FWPCA in general, is the need for agency-wide statistical assistance in the design of experiments or data collection, statistical analysis, and the statistical interpretation of results. This provides a potentially weak link in the sum of research activities and involves sufficient amounts of money and manpower to deserve very careful consideration.

Reports and Papers

A manuscript is being prepared entitled "Effects of Sulfite Waste Liquor (SWL) on Experimental Fertilization of Steelhead Trout."

Plans for 1st Quarter, FY 1970

The Bonneville adult salmon study will be started in July using sockeye salmon adults. The sockeye experiment will be terminated in time for a similar experiment with coho salmon sometime in September.

As water temperature and manpower permit, the tissue enzyme program will continue *in vitro* studies and begin *in vivo* studies using all four species of salmonids.

Work will continue in preparation for fertilization studies with SWL for the fall 1969 spawning season. Chronic toxicity bioassay gear will be prepared for studies of the effects of paper trade wastes.

CONSOLIDATED LABORATORY SERVICES PROGRAM

Status of Projects & Significant Accomplishments

General

The second printing of The Analytical Techniques for the National Eutrophication Research Program was completed. Typographical errors in the first edition were corrected.

Assistance was given to the Shagawa Lake Project in equipment, supplies and manpower to permit the accomplishment of required experiments.

Activities have increased in all programs resulting in a greater input of samples and more requests for analyses. As a consequence, the CLSP is taking advantage of the Work-study Program at Oregon State University, as a source of additional manpower.

Automated Analytical System

The Chief of CLSP discussed Analytical Quality Control with personnel at the Shagawa Lake project at Ely, Minnesota. During the visit and discussions it became apparent that an automated analytical system would benefit the Ely operation. The necessary components for automating chemical analyses were shipped to Ely from Corvallis. These components will result in some loss of efficiency in operations at Corvallis but a decision was made that the need at Ely was greater.

A chemist from CLSP, who is most closely allied with automated analytical systems, assisted Ely personnel in setting up the components sent to Ely. Thereafter, almost daily communication between the

chemists at Shagawa Lake and Corvallis was maintained to resolve operational problems. Effort is being made to automate the Kjeldahl analytical procedure in the CLSP.

Gas Chromatographic Analysis

The Fisher Hamilton gas partitioner, and the clinical model gas partitioner failed due to a burned out thermistor. Parts have been ordered for both units.

The Portland laboratory personnel have been equipping their laboratory to perform organic pesticide analysis using FWPCA Interim Pesticide Methods. The pesticides of particular interest are the chlorinated hydrocarbons.

Atomic Absorption Spectrophotometry

Barium is being used to suppress the ionization of potassium and sodium to increase sensitivity in the analysis of these two ionic constituents normally found in water. An attempt was made to use reagent grade lithium to suppress this ionization but the high level of sodium and potassium precluded the suitability of lithium.

Calcium and magnesium are now being analyzed routinely on unpreserved water samples. Lanthanum chloride with hydrochloric acid are added to sample just prior to analysis to eliminate sulfate, phosphate and aluminum interference.

Aluminum is now being analyzed routinely using nitrous oxide flame in a system buffered with 1000 mg/l potassium to suppress ionization of aluminum.

General Chemical Analysis

A revised method for cyanide determination using a phosphate buffer for pH control and using the pyridine-pyrazalone system for color development has been recommended to Analytical Quality Control as an interim method.

In analyzing for sugars in spent sulfite wastes, the anthrone method fails to give reproducible results. Further evaluation on the anthrone method has been suspended.

Biochemical - Microbiological

A bacterial seed acclimated to decomposition of spent sulfite wastes is being used in the measurement of BOD of spent sulfite liquor wastes.

Long term (20 day) BOD are being run on samples from selected Pollution Surveillance stations to develop k-rates. Nitrification is monitored in the BOD bottle by measuring a nitrogen balance each day.

Areas of Concern

The high level of turnover of temporary intermittent employees is presenting some problems in keeping up with backlog of analyses.

TRAINING AND MANPOWER DEVELOPMENT

9825/000

Status of Projects and Significant Accomplishments

Direct Training

"Laboratory Analyses in Treatment Plant Operations" training course was held May 5-16, 1969 at the Laboratory for a total of 21 trainees.

Cooperative Area Manpower Planning System (CAMPS)

Staff members have met with officials from Oregon, Washington, Idaho and Montana to discuss the various programs through which funds can be obtained for manpower development of sewage treatment plant operators. In addition to institutional-type training at Linn-Benton Community College, Oregon officials have indicated they will apply for on-job-training funds. Twenty operators will be trained in Portland and twenty more will be included in a statewide project. The Municipality of Metropolitan Seattle has applied through the National contract for on-job-training funds for 20 trainees. Idaho has included in their State CAMPS plan a proposed program of institutional training coupled with on-job-training. The University of Idaho will act as the prime contractor. Montana has included in their State CAMPS plan provisions for institutional training to be conducted at Linn-Benton Community College, Albany, Oregon, or possibly at Washington State University, plus provision for one trainer to visit sewage treatment plants in the state for on-job instruction.

Tours and orientation were provided for approximately 225 people during the quarter.

Bill Fitch and Lou Gitto of FWPCA's Systems Analysis Branch conducted a seminar April 28 on statistical treatment of random data, e.g., principal component analysis, for all interested staff at Pacific Northwest Water Laboratory.

Plans for the 1st Quarter, FY 1970

"Water Quality Surveys" training course, July 21-25, 1969.

"Freshwater Pollution Ecology" training course, September 15-19, 1969.

A staff member will make a reconnaissance trip to Alaska in preparation for a training course during the next fiscal year at an Alaska location.